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ORIGINAL ARTICLE

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Discogenic pain in acute nonspecific low-back pain

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Abstract Acute nonspecific low-back pain is characterized by the sudden onset and severe unendurable low-back pain without radicular pain or neurological deficit in the lower extremities. The study was carried out using 55 patients who visited our hospital for acute nonspecific low-back pain, who exhibited degeneration on T2-weighted MR images, and underwent intradiscal injection of local anesthetics,steroid and contrast medium. Intervertebral disc sites with an obvious enhanced region in the posterior annulus of the disc on enhanced T1-weghted MR images was selected for intradiscal injection. When no enhaced region was detected, the most severely degenerated disc on T2-weighted MR images was selected. Acute nonspecific low-back pain with an improvement rate of 70% or higher 5min after injection was judged to be discogenic. The clinical characteristics and pathogenesis of discogenic acute nonspecific low-back pain were investigated. Forty of the 55 patients (73%) had discogenic acute nonspecific low-back pain. As for the characteristics of patients, the mean age was 37 years, and onset occurred upon casual daily movements in 18 patients (45%). Nineteen patients (48%) had bilateral low-back pain, and 29 patients (73%) had no tenderness in the paravertebral muscles. On plain X-ray radiograms, degeneration of the disc was normal or mild in 36 patients(91%). On the discograms, a radial tear extending to the posterior annulus was noted in all patients, but epidural leakage was seen only in six patients (15%). The degree of disc degeneration on T2-weighted MR images (Gibson's classification) was grade 3 in 30 patients (75%). Gadolinium-DTPA enhanced T1-weighted MR images showed an obvious enhanced region in the posterior annulus of the intervertebral disc in 19 patients (48%). As for the clinical characteristics of discogenic acute nonspecific low-back pain, the relatively young adult patients had no tenderness in the paravertebral muscles, and showed moderately degererated intervertebral discs. The pathogenesis of discogenic acute nonspecific low-back pain is mostly considered to be a re-rupture in an asymptomatic ruputured region in the posterior annulus, repaired by granulation tissue, in a moderately degenerated intervertebral disc with a radial tear.

Keywords Discogenic pain · Acute low-back pain · Acute nonspecific low-back pain

Introduction

Acute nonspecific low-back pain is characterized by sudden onset, and a severe unendurable low-back pain without radicular pain or neurological deficit in the lower extremities. The zygapophysial joint [5, 7, 13], an intervertebral disc linked to reproduction of pain during discography, and Sprung back reported by Newmann and co-workers [17] are considered to be the origin of acute nonspecific low-back pain.

However, only a few studies using injection of local anesthetics into the zygapophysial joint have been reported based on the actual pain-eliminating effects, and there has been no report to our knowledge on intervertebral discs other than our report [5, 10]. To investigate the involvement of intervertebral discs in acute nonspecific low-back pain, we injected local anesthetics into the responsible intervertebral disc predicted from MR images, and judged the pain as discogenic pain, which subsided after the injection. Based on patients with discogenic pain, their clinical characteristics and pathogenesis were investigated.

Methods

First, we defined acute nonspecific low-back pain as a state in which patients are unable to move because of acute pain in the lumbar-gluteal region. The pain occurs mainly during movement, lower limb symptoms are absent or mild and may occur as low as the femoral region, and no neurological deficit is observed in the lower extremities. Subjects fulfilling the following conditions were selected for treatment with intradiscal injection. (1) Patients were examined when unable to move within 1 week after the onset, designating the day on which the patient became unable to move as the onset day. (2) Patients consented to MRI, including gadolinium-DTPA(Gd-DTPA) enhanced T1-weighted MR images. (3) Patients had degenerated intervertebral discs (grade 2 or higher in Gibson's classification [8]) on T2-weighted MR images and consented to injection of local anesthetic, contrast medium, and steroids into the disc. (4) Patients had no obvious causative diseases such as trauma, pathological fracture, inflammation, or medical history of lumbar surgery.

Intervertebral disc sites with an obvious enhanced region in the posterior annulus of the disc on enhanced T1-weghted MR images was selected for intradiscal injection (Fig. 1). When the enhanced regions were detected in many intervertebral discs, the disc with the widest enhanced region and highest intensity was selected. When no enhaced region was detected, the most severely degenerated disc on T2-weighted MR images was selected.

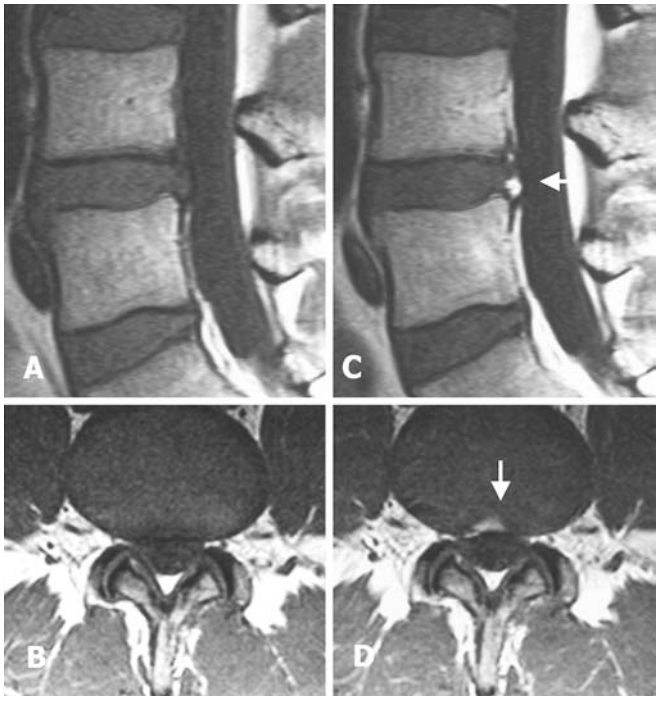

Fig. 1A–D Selection of intervertebral disc for intradiscal injection. **A, B** Sagittal and axial T1-weighted MR images. **C, D** Sagittal and axial Gd-DTPA enhanced T1-weighted MR images. The intervertebral disc containing an obvious enhanced region in its posterior annulus on Gd-DTPA enhanced T1-weighted MR images was selected for intradiscal injection (*arrows*). When an enhanced region was detected in many discs, the disc with the widest and most intense enhanced region was selected. When no enhanced region was detected, the most severely degenerated disc on T2-weighted MR images was selected

A mixture solution (1.5–2.5 ml) of 2% Lidocaine (1 ml), betamethasone sodium phosphate, 2 mg (0.5 ml), and Iotrolan240 (1ml) or Iohexol300 (1 ml) was injected. When judging the effect, the pain level immediately before the intradiscal injection was classed as pain scale 10, and when the pain improvement rate was 70% or higher 5min after intradiscal injection, which was judged as effective.

Materials

Among 83 patients who visited our hospital within 1 week after the onset of acute nonspecific low-back pain between September 2000 and December 2002, 78 patients consented to undergo MRI, including contrast MRI, and 55 patients additionally underwent intradiscal injection. In 23 patients,the injection was not performed because of resolution of the symptoms before the injection in nine, refusal of the injection in seven, risk of infection due to diabetes mellitus in two, and absence of degeneration on MR images in five.

The investigated items were: (1) outline of the case; (2) clinical symptoms (a) past history of acute low-back pain, (b) onset pattern, (c) triggering factor, (d) pain region, and (e) physical findings; (3) imaging findings (a) plain X-ray radiograms, (b) discograms, and (c) MR images.

Results

Outline of discogenic acute nonspecific low-back pain

A pain-eliminating effect following intradiscal injection was observed in 40 of the 55 patients (73%), including 29 males and 11 females. Ages ranged from 22 to 71 years, with a mean of 37 years and 35 of the 40 patients under 50 years (87%). The interval before the initial examination after the onset ranged from the onset day to the fourth day (mean: 1.1 days), the interval before undergoing MRI after the onset ranged from the onset day to the eighth day (mean: 1.6 days), and the interval before intradiscal injection after the onset ranged from the onset day to the eighth day (mean: 1.7 days). The intervertebral disc level for intradiscal injection was L1/2 in one (3%), L3/4 in two (5%), L4/5 in 18 (45%), and L5/S1 in 19 (48%).

Clinical symptoms

Past history of acute low-back pain

Interviewing for past history of acute low-back pain could be performed in 38 of the 40 patients. Twenty-two patients had previous acute low-back pain (second time in 14, third in one, fourth in three, and more than five times in two), while 16 patients had no previous acute low-back pain. In the 22 patients with previous acute low-back pain, the period between the first and second onsets was 1–19 years with a mean of 4.4 years.

Onset pattern

The onset patterns could be divided into three types. Twenty patients (50%) became unable to move because of sudden severe low-back pain. Nine patients (23%) felt sudden mild low-back pain or a strange sensation in the lumbar region and gradually became unable to move after several hours, or suddenly became unable to move after a few days. In 11 patients (27%), low-back pain gradually deteriorated without a triggering factor, and the patients gradually became unable to move after several hours or suddenly became unable to move after a few days.

Triggering factor

The triggering factor was casual daily movement in 18 patients (45%), movements related to a half-sitting posture, such as bending forward to pick something up or standing up, in 13, while pain onset occurred when they coughed, turned in bed, or turned around in five. Pain began while lifting a heavy object in eight patients (20%): about 2–3 kg for one, about 5–10 kg for two, and about 20–30 kg for five. Pain began while playing volleyball in one and working on a farm in one. There was no obvious triggering factor in 12 patients (30%).

Pain region

Bilateral and unilateral low-back pain occurred in 19 (48%) and 21 (52%) patients, respectively (Fig. 2). Ten patients (25%) felt mild heaviness and numbness in the femoral region, while two and eight had bilateral and unilateral low-back pain, respectively.

Physical findings

A motion test of the lumbar spine was performed in 20 patients who were able to stand. Flexion and extension were restricted in six and four patients, respectively, and both were restricted in ten patients. A straight leg raising test (SLRT) was normal in 17 (43%), 30–70° in 18 (45%), and less than 30° in five (13%). Eleven patients (27%) had tenderness in the paravertebral muscles. The visual analogue scale (VAS with a maximum scale of 10) was 8–10 (mean: 9.2).

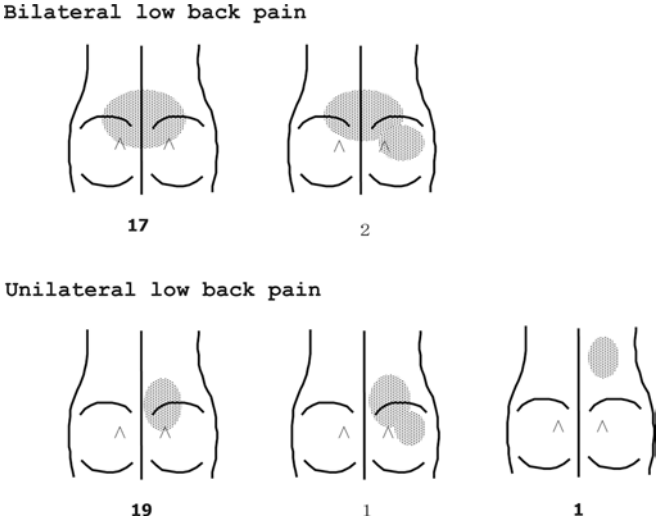

Fig. 2 Pain region. Nineteen (48%) and 21 (52%) patients had unilateral low-back pain and bilateral low-back pain, respectively

Imaging findings

Plain X-ray radiograms

The degree of degeneration of the responsible intervertebral disc determined using Lawrence's classification [15] was normal in one (3%), grade 1 in 35 (88%), grade 2 in three (8%), and grade 3 in one (3%), and no patient was rated grade 4.

Discograms (responsible intervertebral disc)

A radial tear extending to the posterior annulus was detected in all patients. On the Adams's classification [1], the radial tear was the fissured type in 34 patients (85%) and the ruptured type in six (15%).

MR images

Degree of disc degeneration on T2-weighted MR images The degree of degeneration of the responsible intervertebral disc was rated using Gibson's classification [7],designating an internuclear cleft as grade 1. The degeneration was grade 2 and grade 3 in 10 (25%) and 30 (75%) patients, respectively. Grade 4 severe degeneration, in which the signal completely disappears, was not detected in any of the patients.

High-intensity zone in the posterior annulus of the intervertebral disc on T2-weighted MR images High-intensity zones [2] in the posterior annulus of the intervertebral disc considered to reflect symptomatic intervertebral disc disorder were observed in 12 patients (30%). The zone was consistent with the enhanced region in the Gd-DTPA enhanced T1-weighted MR images in all patients.

Changes in intensity in end-plates The intensity changed in the responsible intervertebral end-plate in ten patients (25%), and changes were slight. The Modic's classification [11] was type 1 in four, type 2 in three, and type 3 in two, and one patient could not be classified.

Degree of protrusion of the intervertebral disc on T1- and T2-weighted MR images On Jensen's classification [12], the degree of protrusion of the responsible intervertebral disc was normal in three (8%), bulge in 11 (28%), protrusion in 19 (48%), and extrusion in seven (18%). Two of seven patients with discs classified as "extrusion" had lateral disc herniation.

Gd-DTPA enhanced T1-weighted MR images An obvious enhanced region was detected in the posterior annulus of the intervertebral disc in 19 of 40 patients (48%) (Fig. 1). The numbers of enhanced intervertebral discs observed were one disc in 16 patients, two in two patients, and three in one patient.

Discussion

There have been only a few clinical reports on the involvement of intervertebral discs in acute nonspecific low-back pain. Park and co-workers [18] re-investigated 14 patients in whom rupture of the posterior annulus was detected on discograms, and concluded that the cause of severe disabling low-back pain was a ruptured posterior annulus based on the reproduction of pain during discography. However, reproduction of pain during discography alone cannot reliably demonstrate the relationship with actual clinical symptoms [3]. We considered the degenerated disc on T2-weighted MR images and the enhanced region in the posterior annulus on Gd-DTPA enhanced T1-weighted MR images as the responsible disc for acute nonspecific low-back pain, and administered an intradiscal injection. The pain was eliminated in 40 of 55 patients (73%). Accordingly, in patients unable to move the body because of severe acute low-back pain, the pain was discogenic in most cases.

There has been no report to our knowledge describing the clinical features of discogenic acute nonspecific low-back pain. In this study, we investigated the clinical characteristics of acute nonspecific low-back pain for which intradiscal injection was effective. In many cases, onset occurred upon casual daily movements, and many patients repeatedly deteriorated. Few patients had tenderness in the paravertebral muscles. Acute nonspecific low-back pain with such clinical findings is very likely to be discogenic.

The presence of discogenic low-back pain has been assumed based on reproduction of pain during discography, disappearance of low-back pain after anterior lumbar spinal fusion, and reproduction of low-back pain by stimulation of the annulus and posterior longitudinal ligament during lumbar surgery under local anesthesia, as reported by Kuslich and co-workers [14]. Since a radial tear from the nucleus to the surface layer of the annulus and nociceptors were observed in the outermost layer of the annulus in these cases, a rupture extending the outermost layer of the annulus was considered to be the cause of discogenic low-back pain [4, 6, 9, 16]. In patients with discogenic acute nonspecific low-back pain in this study, the radial tears were detected by discography in all patients. The images of radial tears indicated that rupture of the intervertebral disc extended to the outer most layer of the annulus containing nociceptors, suggesting that discogenic acute nonspecific low-back pain developed on the basis of an intervertebral disc disorder, similar to that in discogenic low-back pain.

Unlike usual low-back pain, acute nonspecific low-back pain is characterized by sudden onset and complete disability of movement because subsequent severe low-back pain is induced even by slight movement. In patients diagnosed with discogenic acute nonspecific low-back pain in this study, no severe disc degeneration was detected on plain X-ray radiograms or T2-weighted MR images. The inner pressure of these discs may have been higher than that in cases with severely degenerated discs, and a slight increase in inner pressure due to body movement may have been easily transmitted directly to nociceptors in the outermost layer of the annulus. Accordingly, after the annulus was ruptured, a slight increase in inner pressure caused by body movement may have acted as a noxious stimulus, leading to complete disability of movement.

Ross and co-workers [19] reported that the enhanced region in the vertebral discs on Gd-DTPA enhanced T1-weighted MR images corresponded to the ruptured annulus, and histologically, the region consisted of granulation tissue. In this study, an obvious enhanced region was detected in the posterior annulus in about 50% of patients with discogenic acute nonspecific low-back pain. Since many MR images were obtained on the onset day or the following day, it is unlikely that granulation tissue had formed, reflecting tissue repair, at such an early time after the onset. It may have already been present as an asymptomatic lesion before the onset, and this physically weak region may have ruptured again, causing discogenic acute nonspecific low-back pain. This hypothesis is supported by the finding that discogenic acute nonspecific low-back pain onset occurred upon casual daily movements, and occurred repeatedly. In addition, Gd-DTPA enhanced T1-weighted MR images were useful for selection of the intervertebral disc for the itradiscal injection.

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